



Evaluation of EPA's Test for Pressure Regulating Sprinklers

Irrigation Show & Education Conference
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Background

- ASABE/ICC Sprinkler & Emitter Standard

Committee Composition

- Irrigation manufacturers
- Utilities
- Irrigation Association
- Irrigation contractors
- Researchers

ASABE/ICC 802-2014

Landscape Irrigation Sprinkler and Emitter Standard

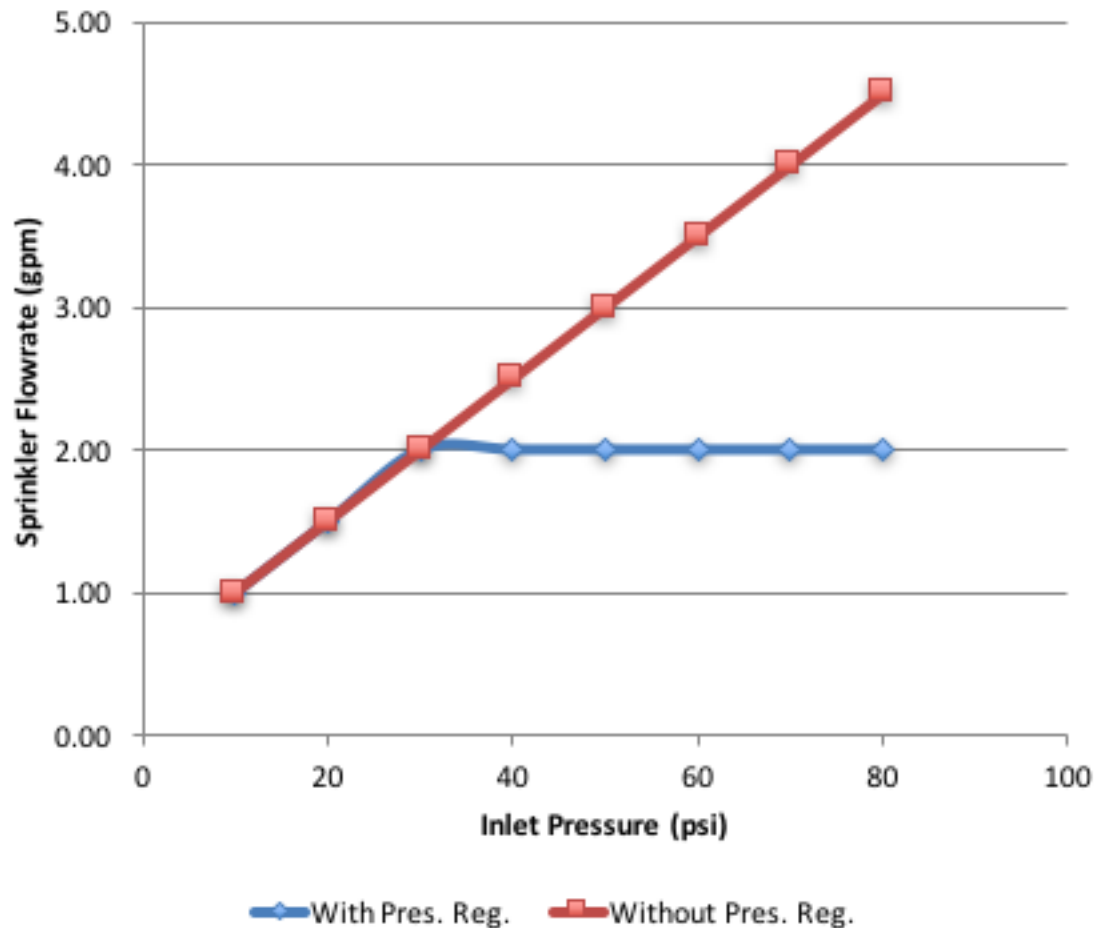
American National Standard



Background




- ASABE/ICC Sprinkler & Emitter Standard
- Potential savings → flowrate reduction at elevated operating pressures

Theoretical Pressure Regulation Flowrate Reduction






Pressure and Flowrate

12' SERIES WITH 24° TRAJECTORY (BROWN)



Arc	Desc.	psi	gpm	Ra- dius	Prec. Rate	
					▲	■
90° 	12-Q	20	0.40	11	1.48	1.28
		30	0.50	12	1.55	1.35
		40	0.60	13	1.64	1.42
		50	0.63	13	1.67	1.44
	12-Q-PC	30-40	0.48	12	1.49	1.29
		40-75	0.53	12	1.65	1.43
120° 	12-T	20	0.57	11	1.58	1.37
		30	0.72	12	1.68	1.45
		40	0.87	13	1.87	1.62
		50	0.97	13	1.93	1.67
	12-T-PC	30-40	0.64	12	1.49	1.29
		40-75	0.70	12	1.63	1.41
180° 	12-H	20	0.95	11	1.76	1.52
		30	1.09	12	1.69	1.47
		40	1.30	13	1.72	1.49
		50	1.55	14	1.77	1.53
	12-H-PC	30-40	0.96	12	1.49	1.29
		40-75	1.05	12	1.63	1.41

12 12' radius
 Fixed: ¼, ⅓, ½, ⅔, ¾, Full
 ● Green Trajectory: 28°

Arc	Position	Pressure	Radius	Flow	Precip in/hr	
		PSI			ft.	GPM
90° 	Q	20	11	0.54	1.71	1.98
		25	12	0.61	1.62	1.87
		30	12	0.67	1.78	2.06
		35	13	0.72	1.65	1.90
		40	13	0.78	1.77	2.04
120° 	T	20	11	0.72	1.71	1.98
		25	12	0.81	1.62	1.87
		30	12	0.89	1.78	2.06
		35	13	0.97	1.65	1.90
		40	13	1.04	1.77	2.04
180° 	H	20	11	1.05	1.67	1.93
		25	12	1.18	1.58	1.83
		30	12	1.30	1.74	2.01
		35	13	1.42	1.61	1.86
		40	13	1.52	1.73	2.00




12 Series MPR

30° Trajectory




Nozzle	Pressure psi	Radius ft.	Flow gpm	Precip In/h	Precip In/h
	15	9	1.80	2.14	2.47
	20	10	2.10	2.02	2.34
	25	11	2.40	1.91	2.21
	30	12	2.60	1.74	2.01
	15	9	0.90	2.14	2.47
	20	10	1.05	2.02	2.34
	25	11	1.20	1.91	2.21
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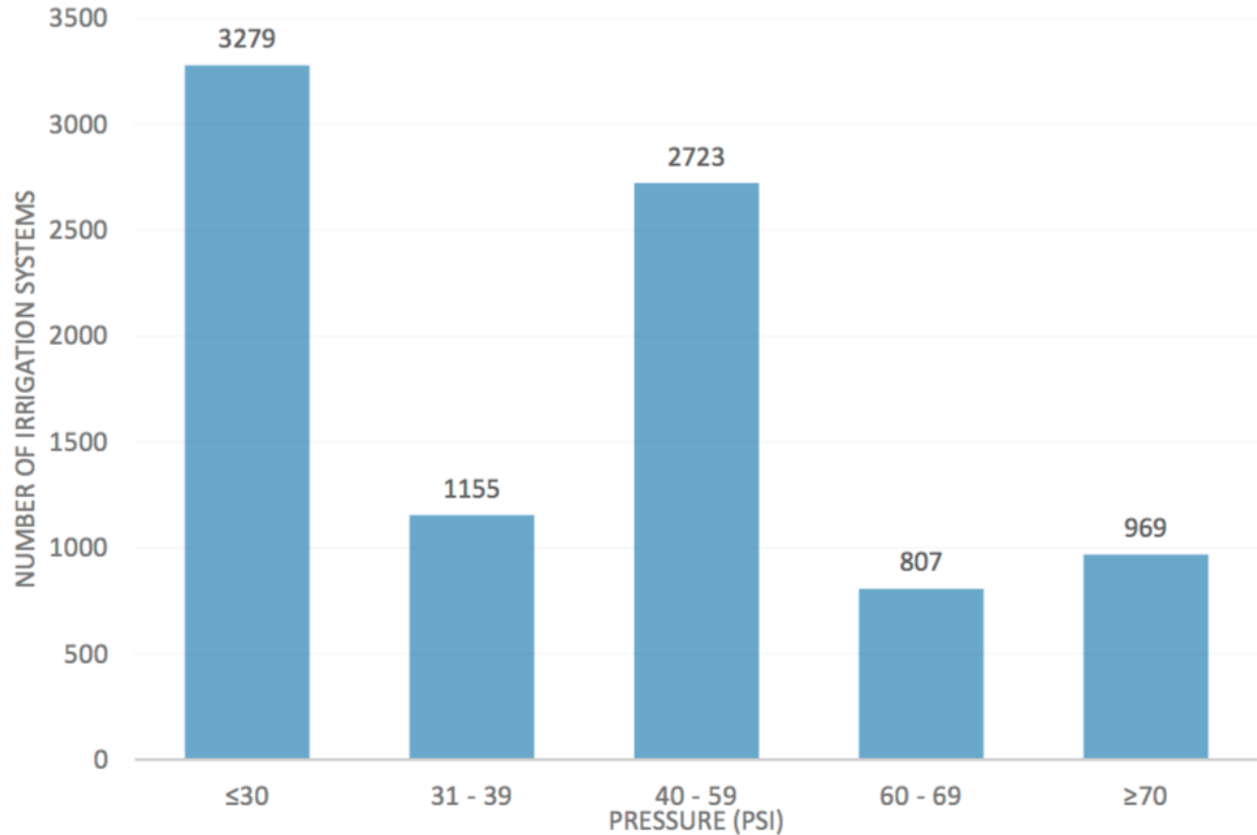
12 Series MPR

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EPA Estimated Savings

- Avg. house using 50,500 gal/yr saves 5,600 gal/yr
- 2.3 yr ROI retrofit
- 1.5 yr ROI new install



Irrigation System Pressure Data, Utah State University and Center for Resource Conservation

Misting and Drift



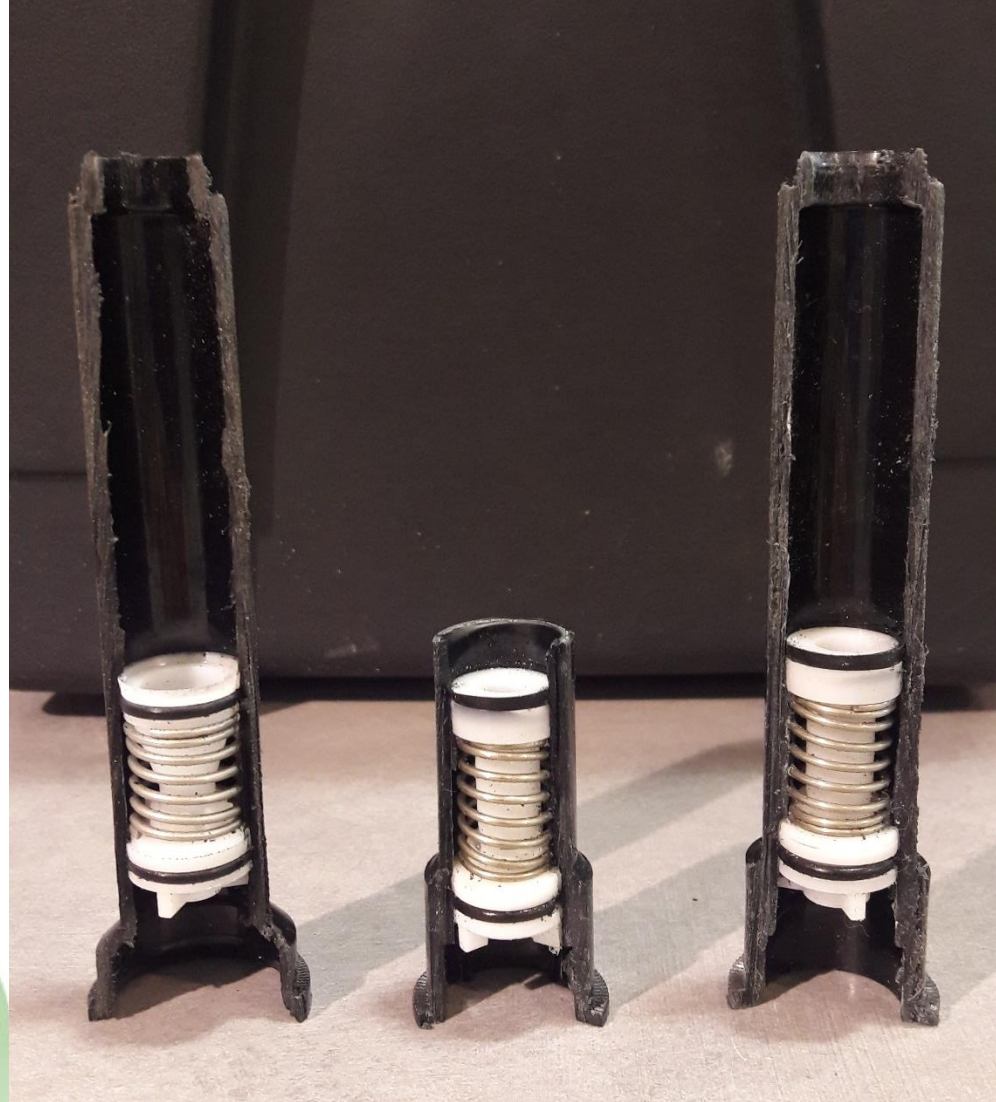
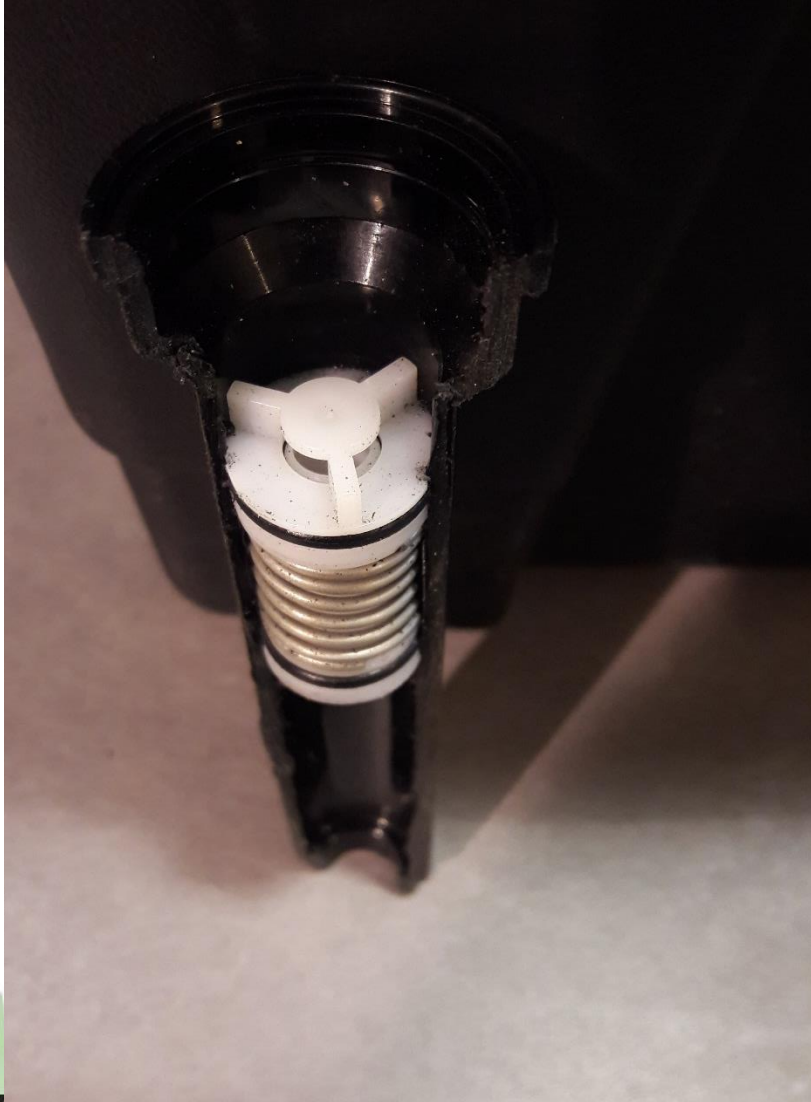
Pressure Regulation



No Pressure Regulation



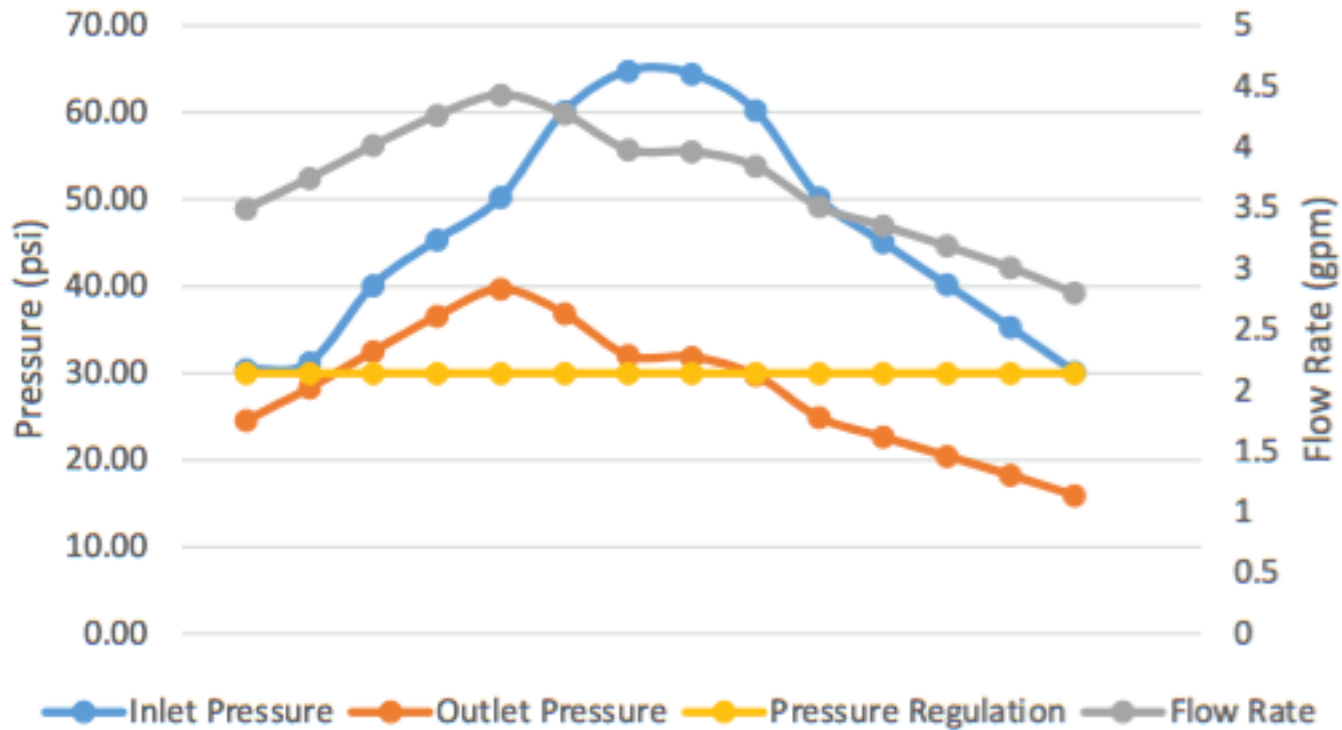
How Do They Work?



EPA WaterSense Initial Testing

- Three labs
- Outlet device
 - Standardized orifice in 802
 - Ball valve/gate valve
 - Variable arc nozzle
 - Needle valve
- Increasing pressure/decreasing pressure
→ hysteresis

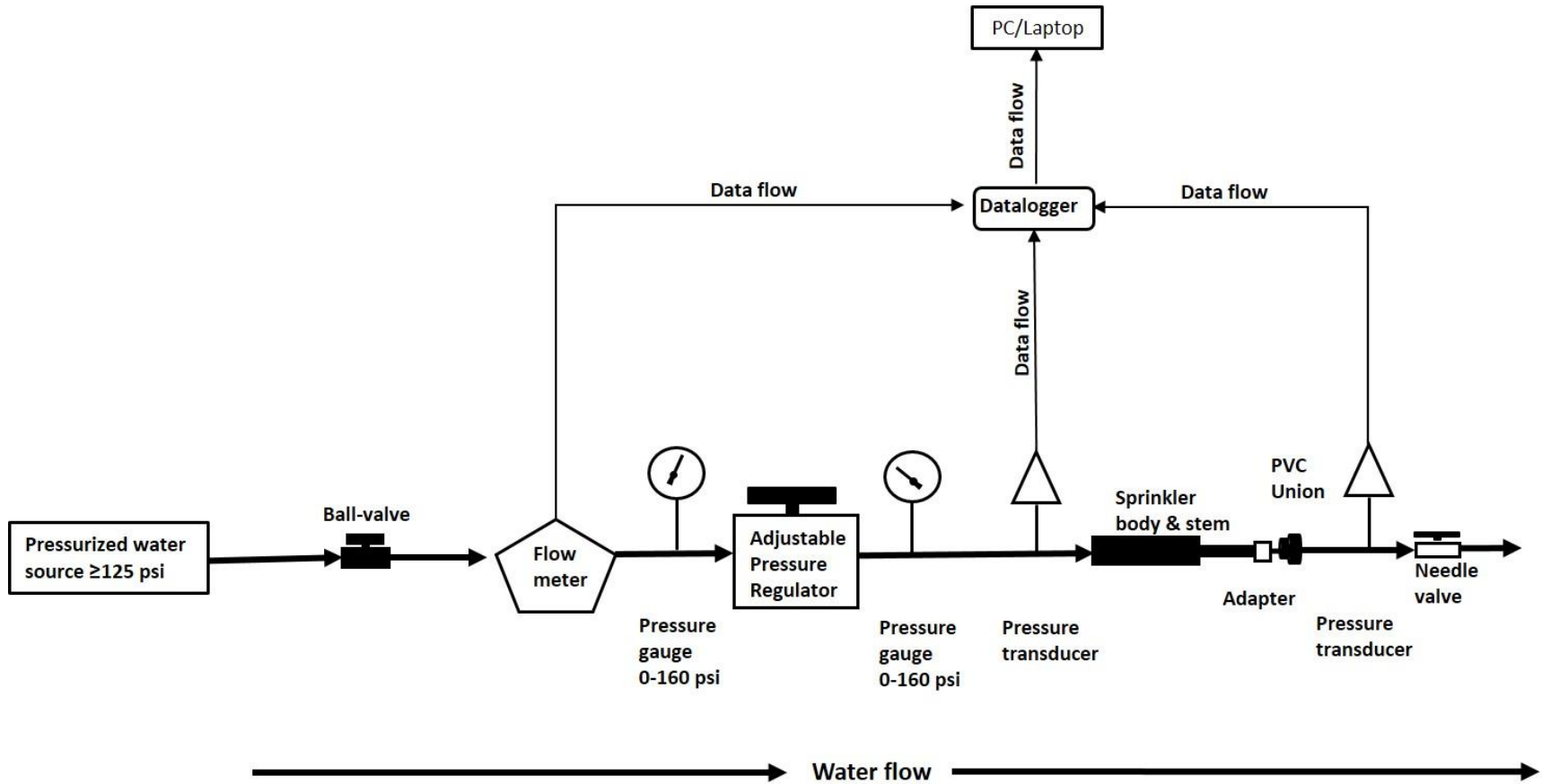
Initial Testing Observed Hysteresis



Outline

- Test equipment
- Test process
- Modifications
- Results
- Recommendations

Test Equipment



Water
Hammer
Arrester



Laptop



Datalogger



Flowmeter



Booster
Pump







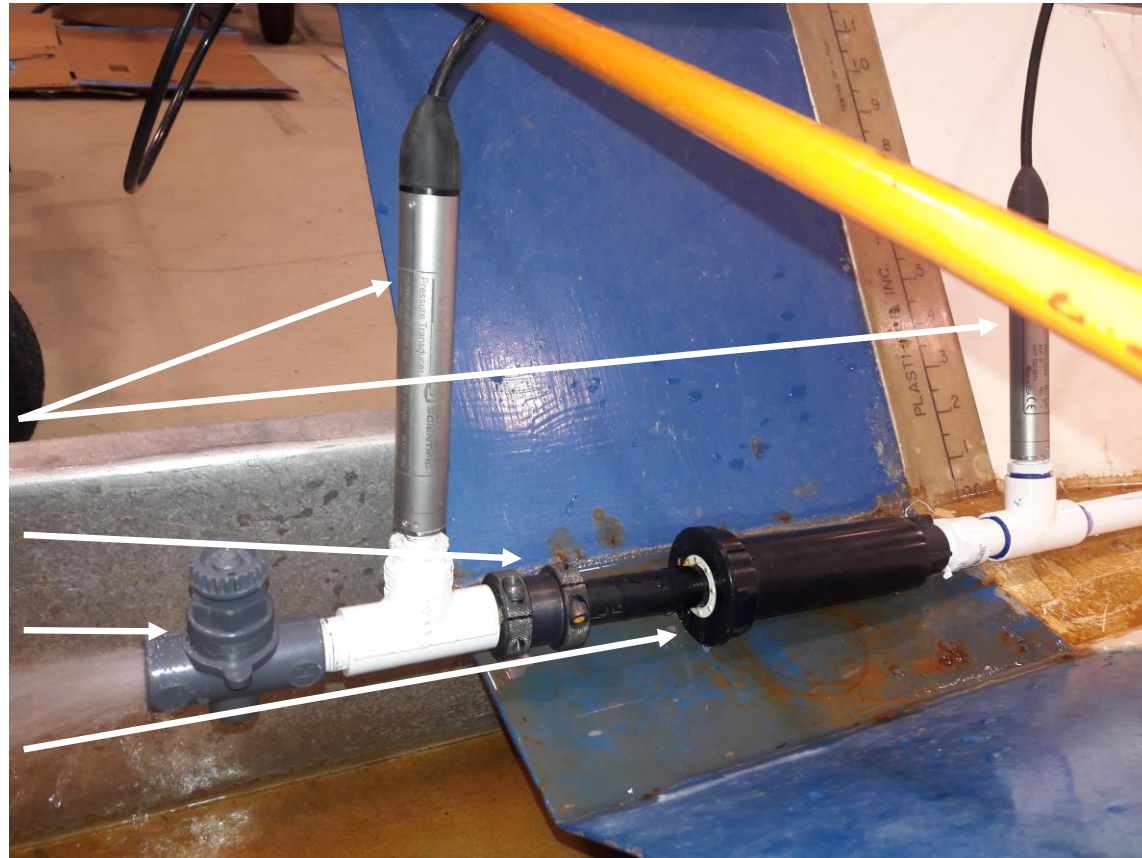
Test Sample, pressure transducers, needle valve

Pressure
Transducers

Adapter

Needle
Valve

Test
Specimen



Test Process

- Verify flowrate at rated pressure (3 consecutive readings) 30 psi +/- 1 psi, 1.5 gpm +/- 0.1 gpm
- Reduce pressure to zero (for at least 1 min)
- Increase pressure to rated+10 psi (3-5 min test, 30 sec recording)
- Reduce pressure to zero
- Increase pressure to 60 psi
- Reduce pressure to zero
- Increase pressure to 70 psi
- Repeat for 60 psi, rated+10 psi

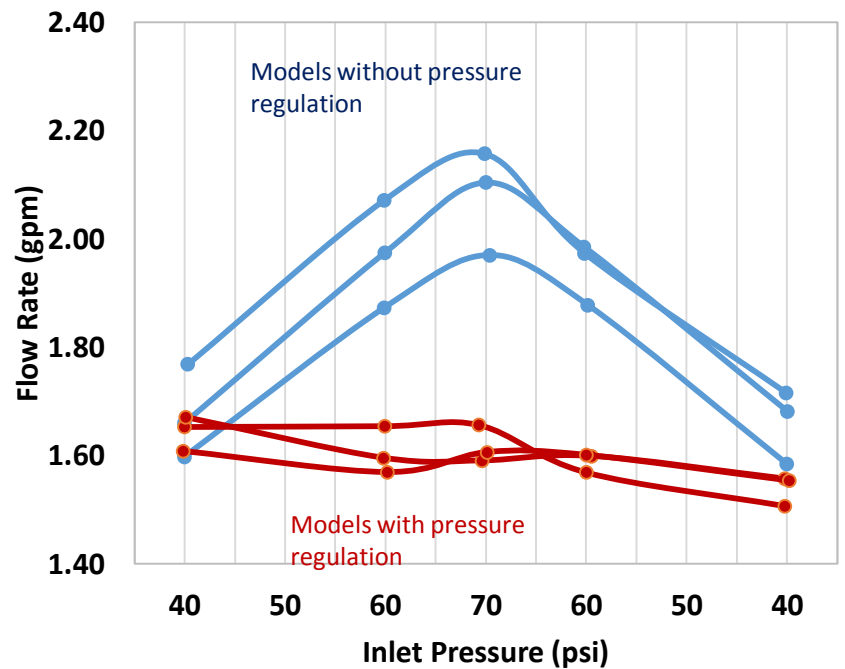
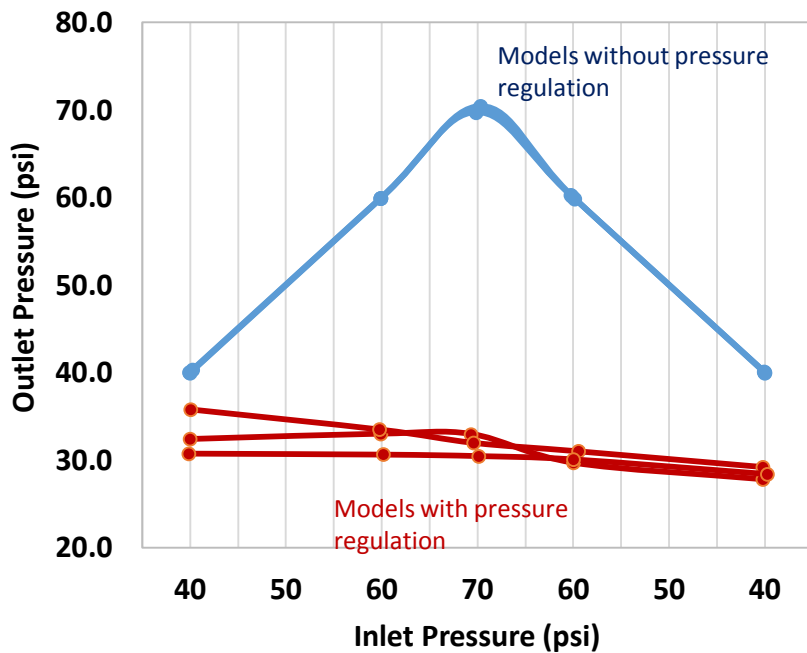
Test Modifications

- All piping ½” SCH 40 PVC, not ¾”
- First test point at regulated pressure to verify test conditions
- Accepted a 0.2 gpm deviation at 3.5 gpm test point

Models Tested

- 6 manufacturers
- 11 models tested, 3 samples each
- Brands A-C, PR and non-PR models tested
- One check valve model
- Two flow reduction models

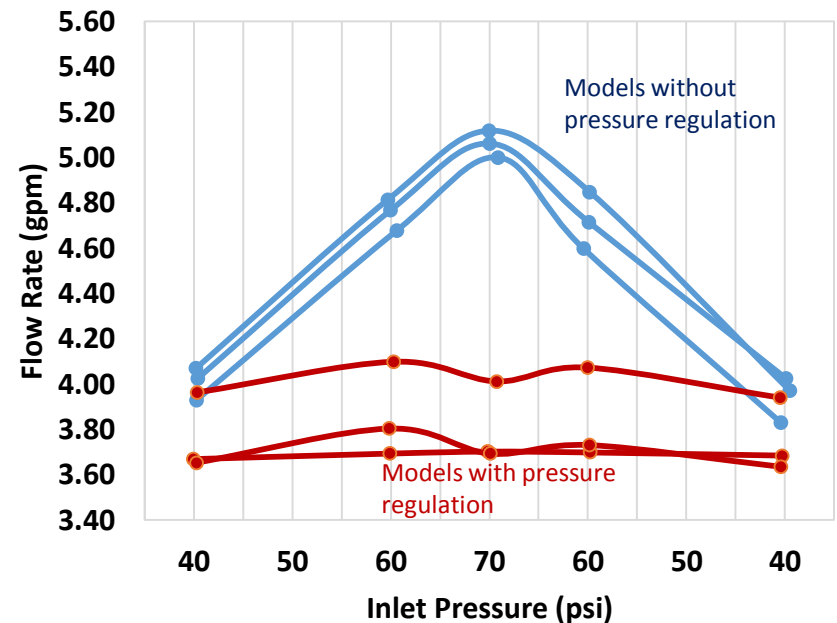
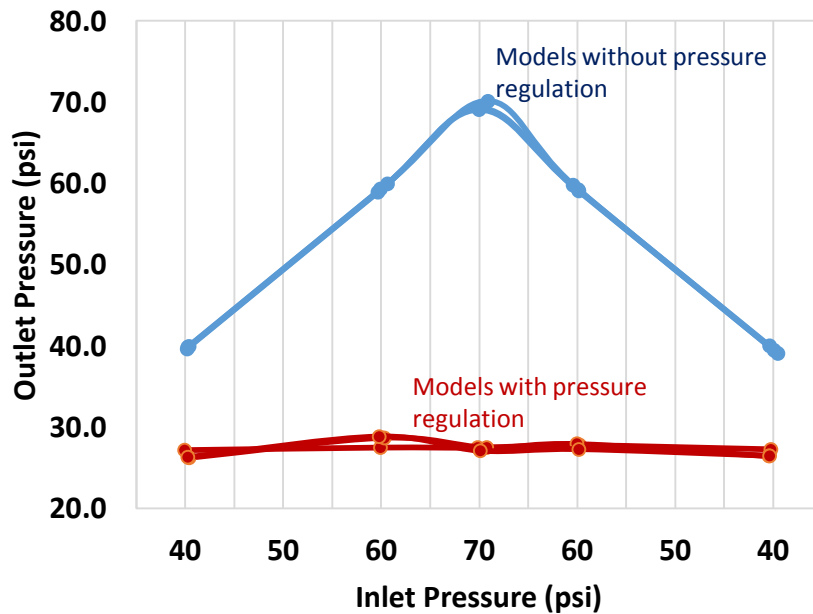
Brand A Pressure Regulated vs. Non-Pressure Regulated – 1.5 gpm Test



—●— #1 —●— #2 —●— #3 —●— #1 —●— #2 —●— #3

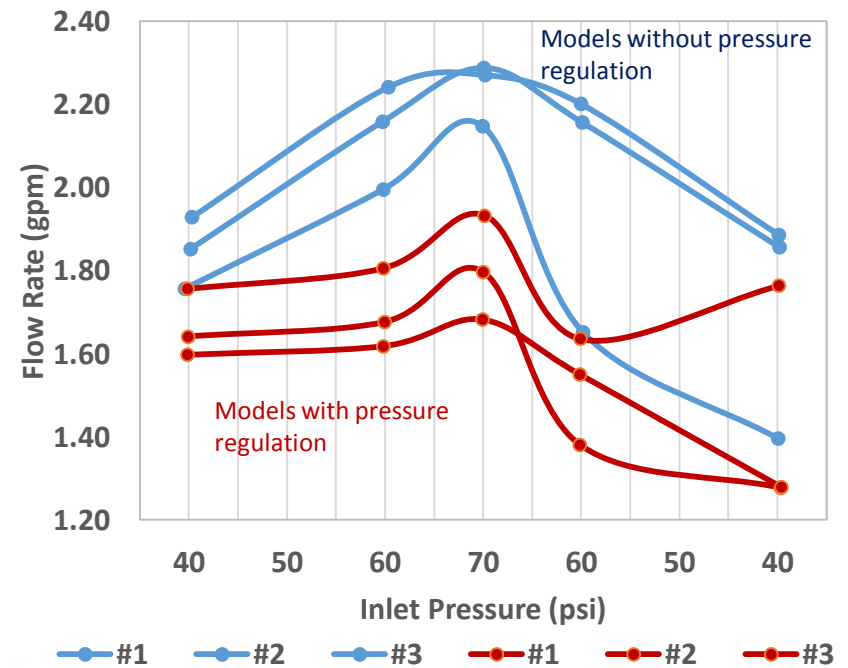
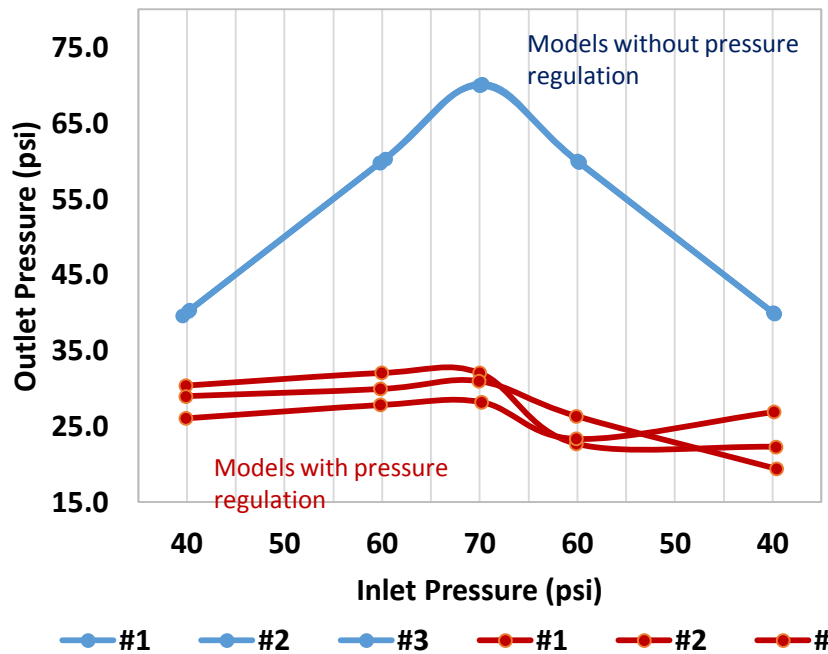
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Brand A Pressure Regulated vs. Non-Pressure Regulated – 3.5 gpm Test

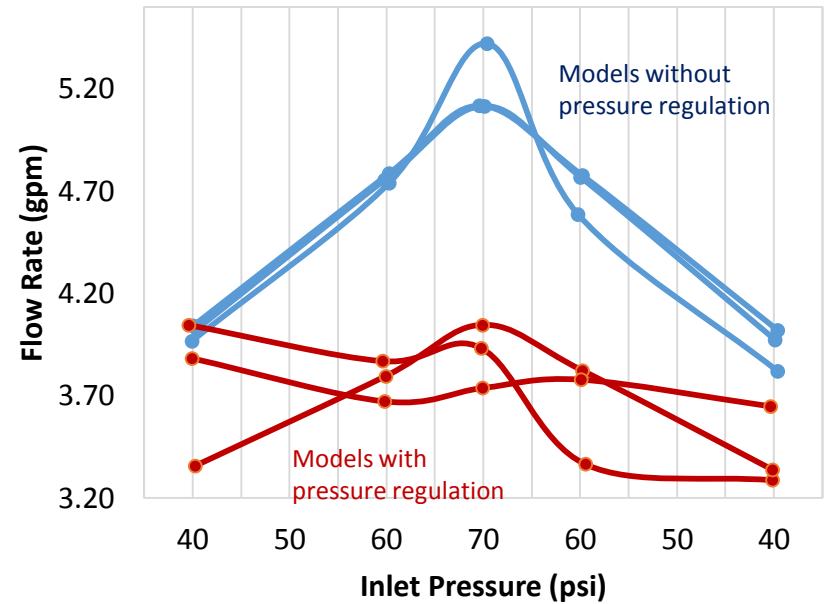
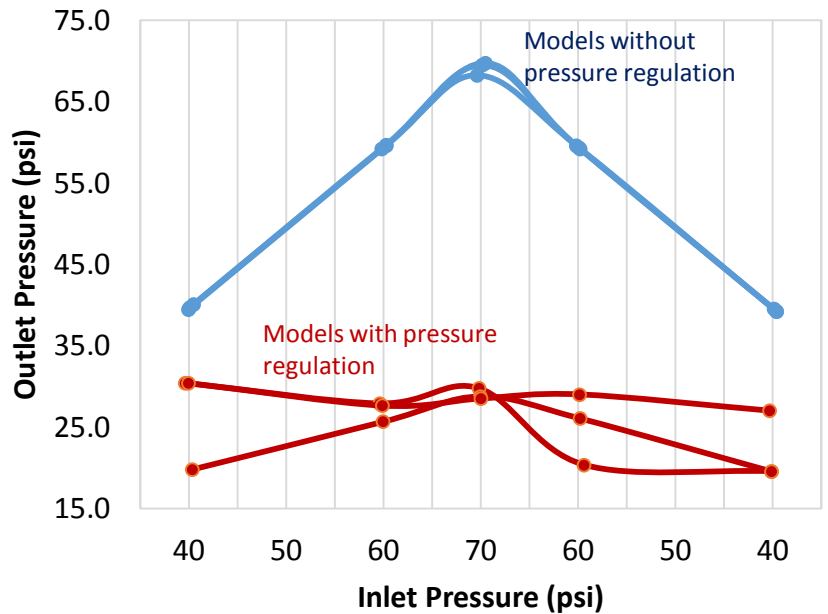


● #1 ● #2 ● #3 ● #1 ● #2 ● #3
 ● #1 ● #2 ● #3 ● #1 ● #2 ● #3

Brand B Pressure Regulated vs. Non-Pressure Regulated – 1.5 gpm Test



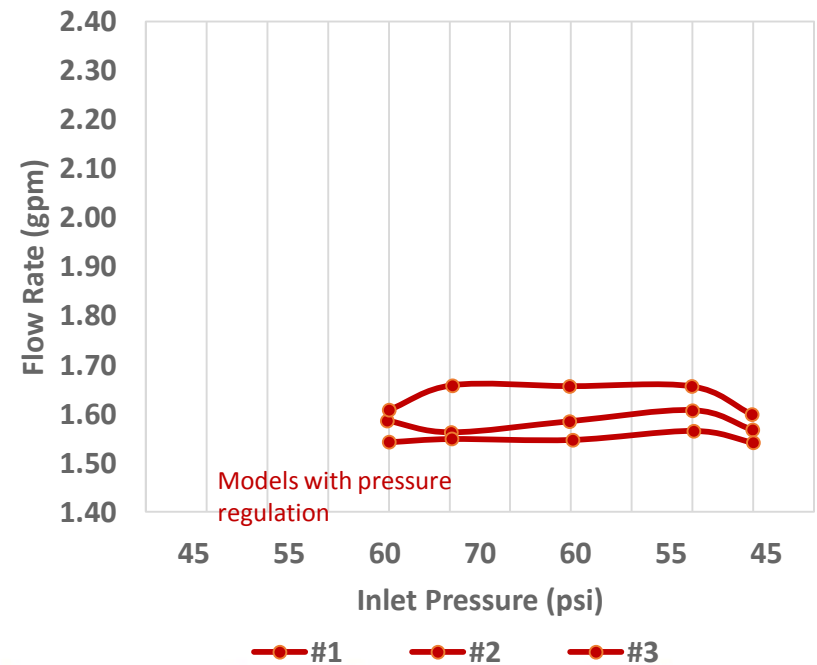
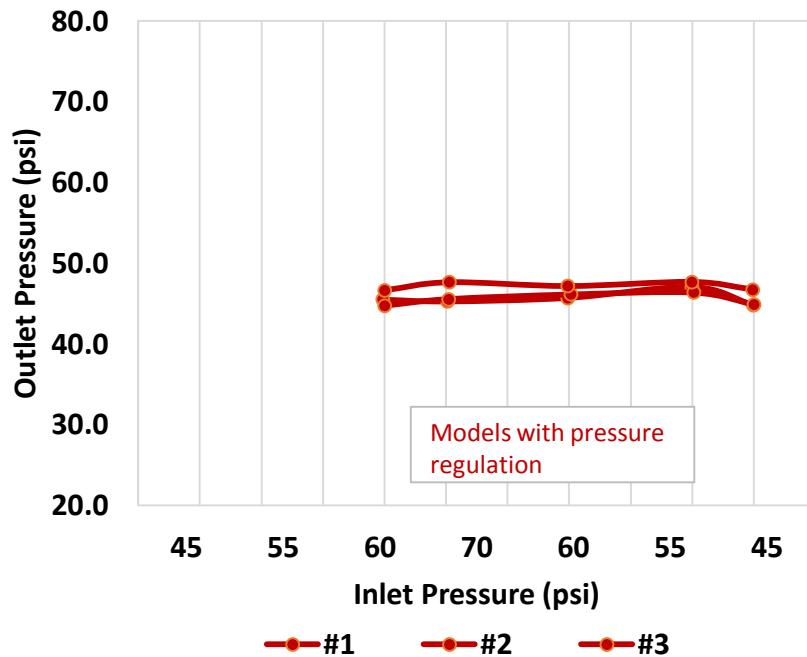
Brand B Pressure Regulated vs. Non-Pressure Regulated – 3.5 gpm Test



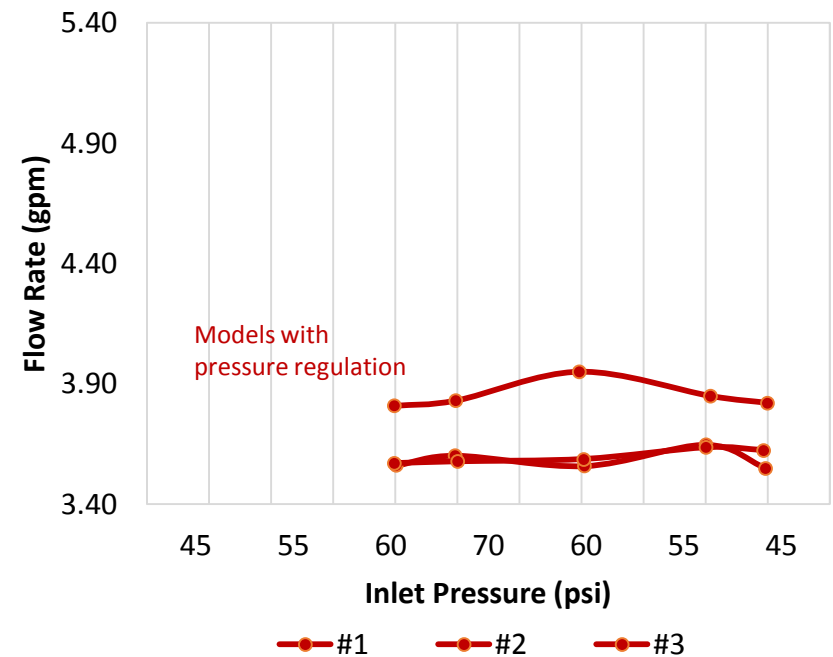
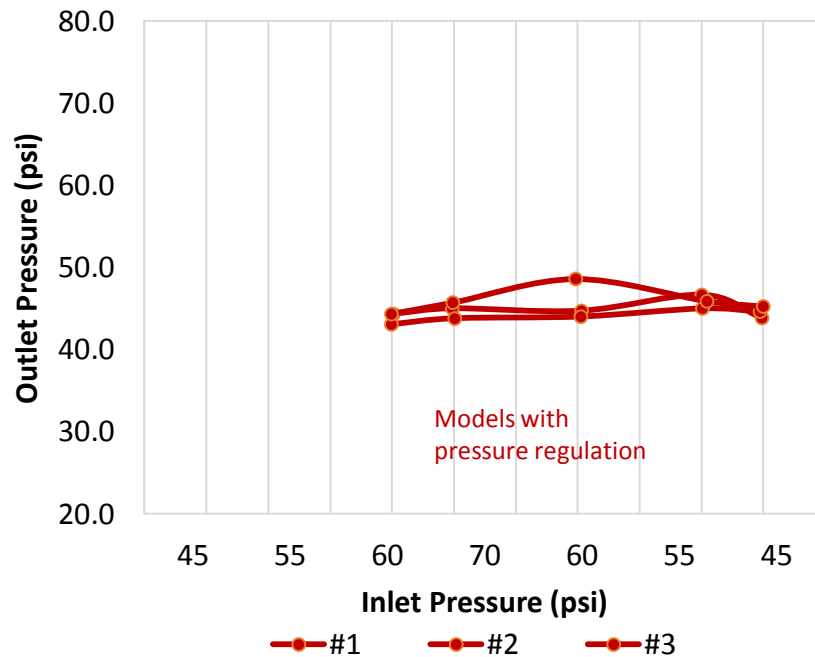
—●— #1 —●— #2 —●— #3 —●— #1 —●— #2 —●— #3

—●— #1 —●— #2 —●— #3 —●— #1 —●— #2 —●— #3

Brand E PRB & Check Valve – 1.5 gpm Test



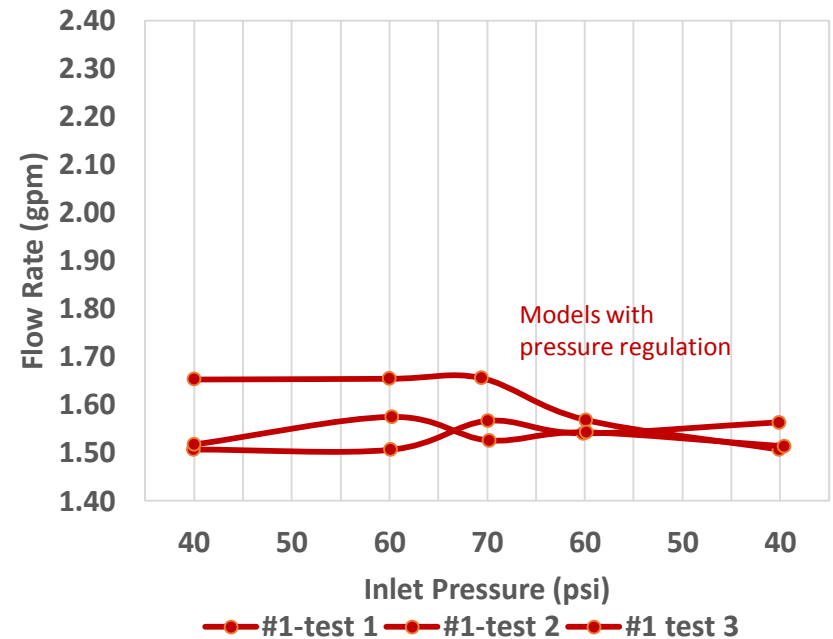
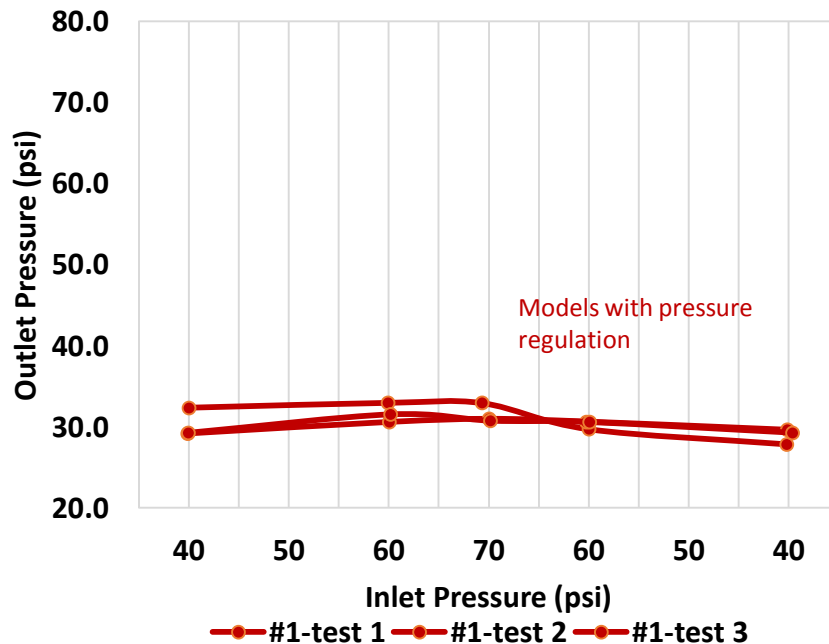
Brand E PRB & Check Valve – 3.5 gpm Test



PRB Replicate Tests— Brand A Sample

#1

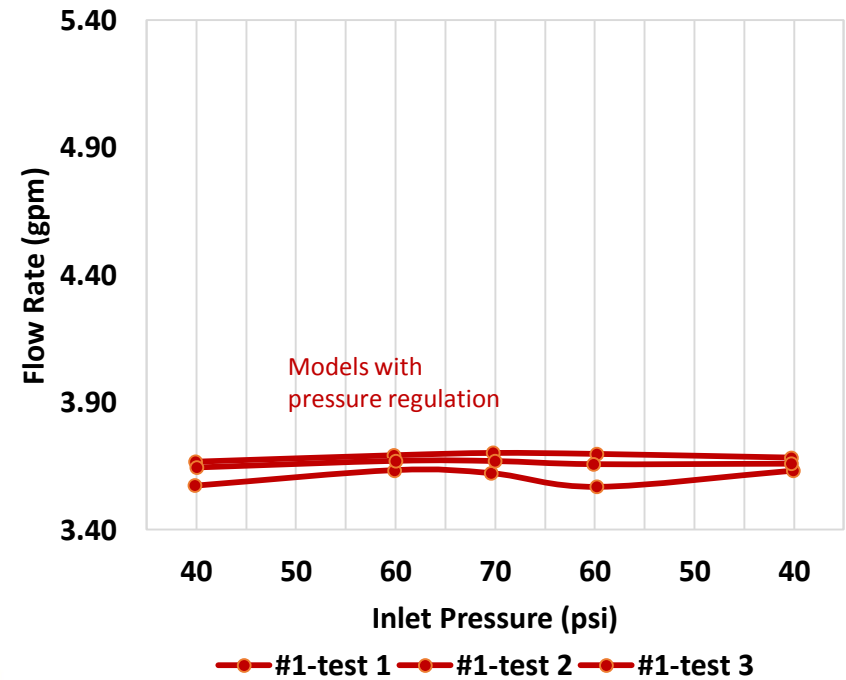
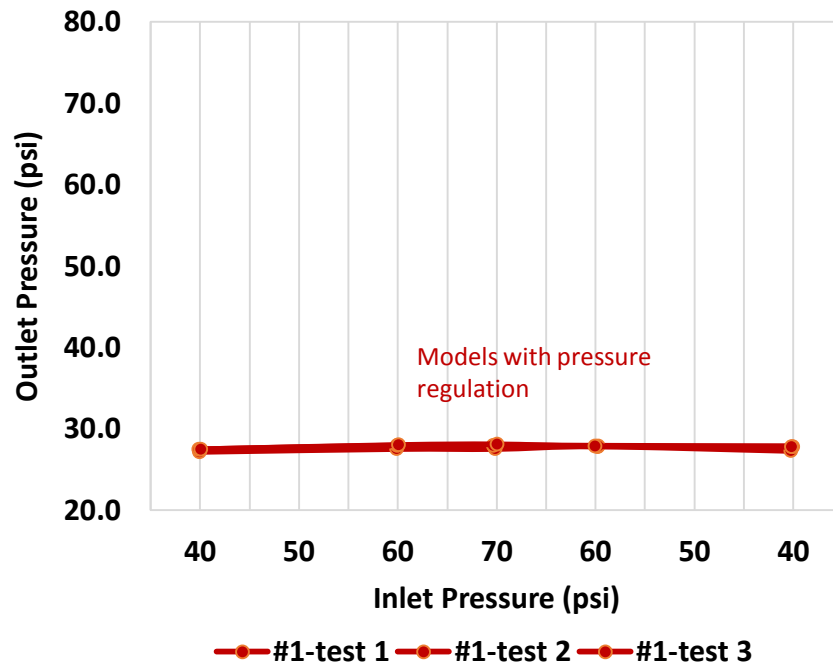
1.5 gpm



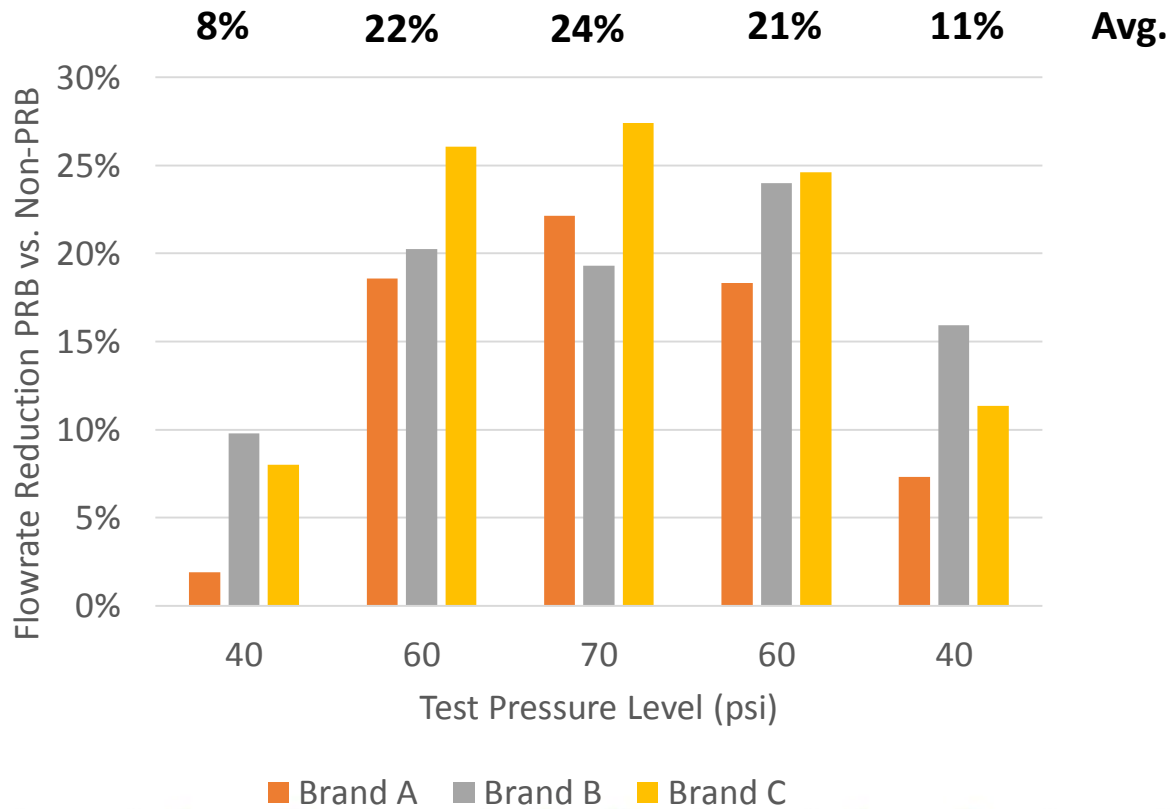
PRB Replicate Tests— Brand A Sample

#1

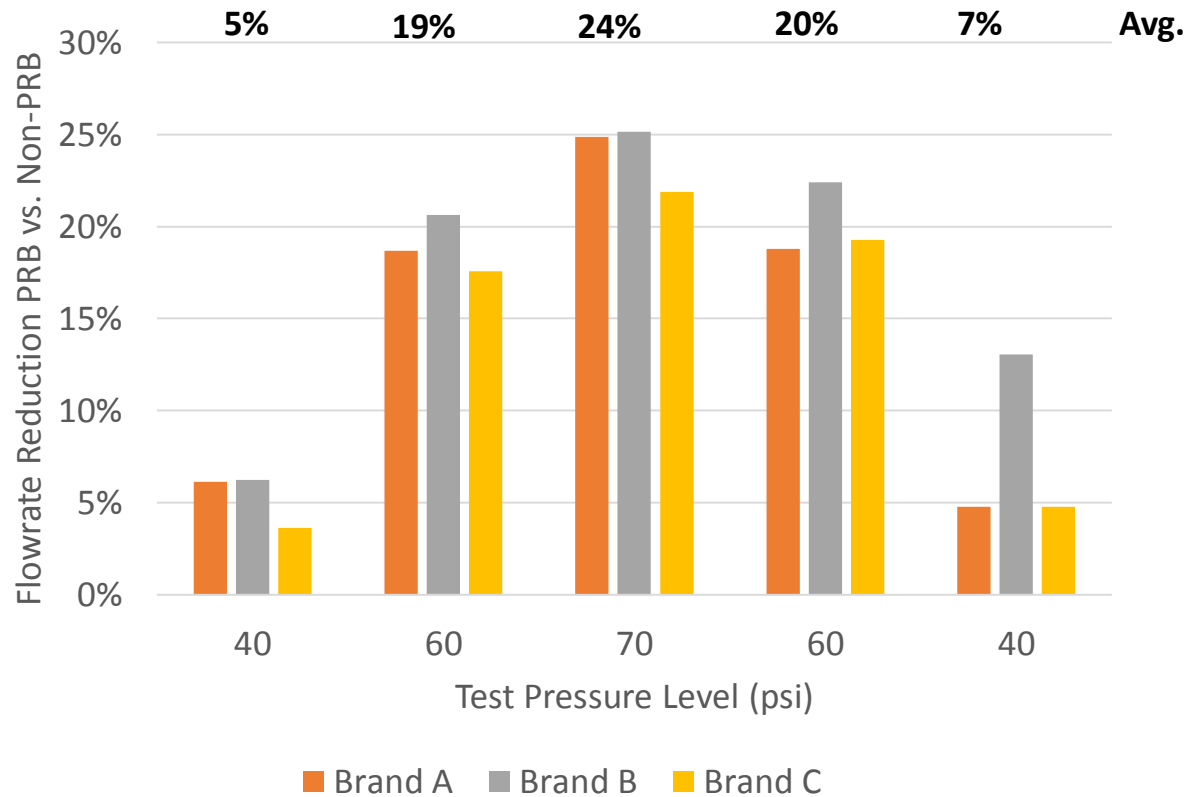
3.5 gpm



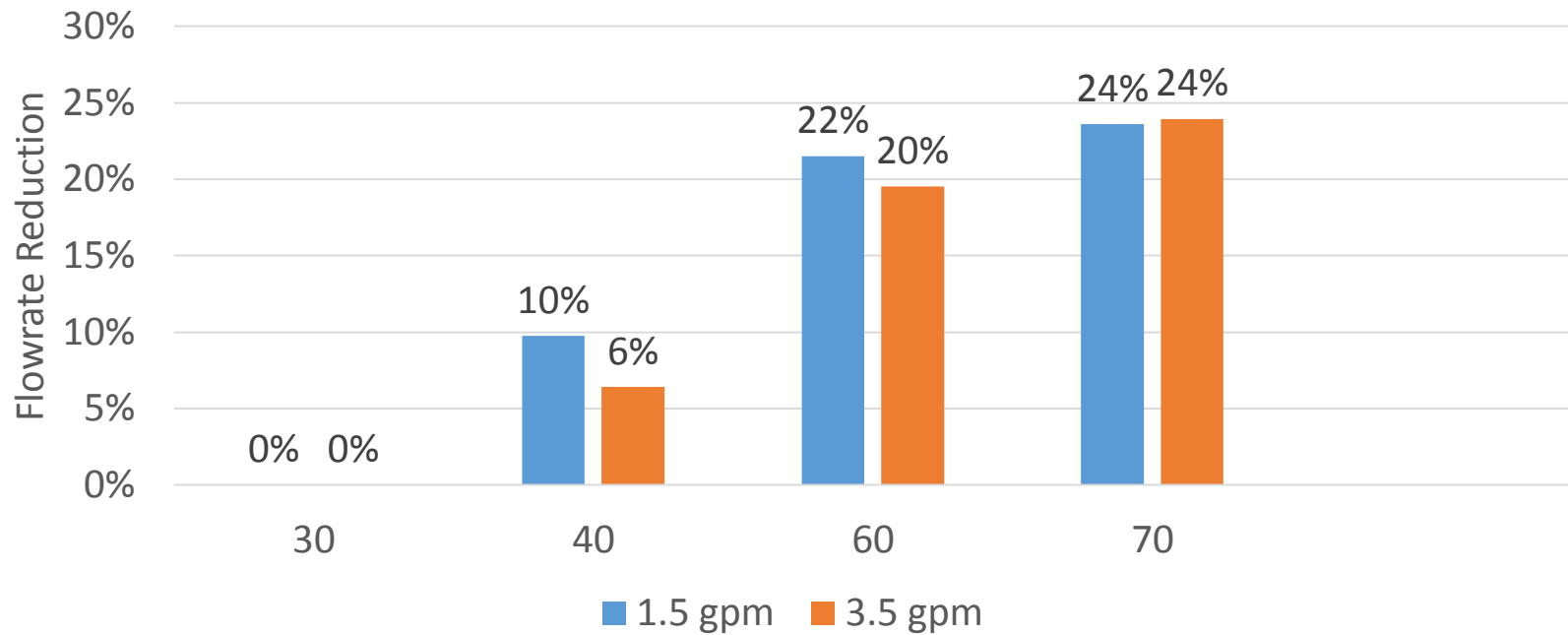
Flowrate Reduction – PRB vs. Non-PRB @ 1.5 gpm



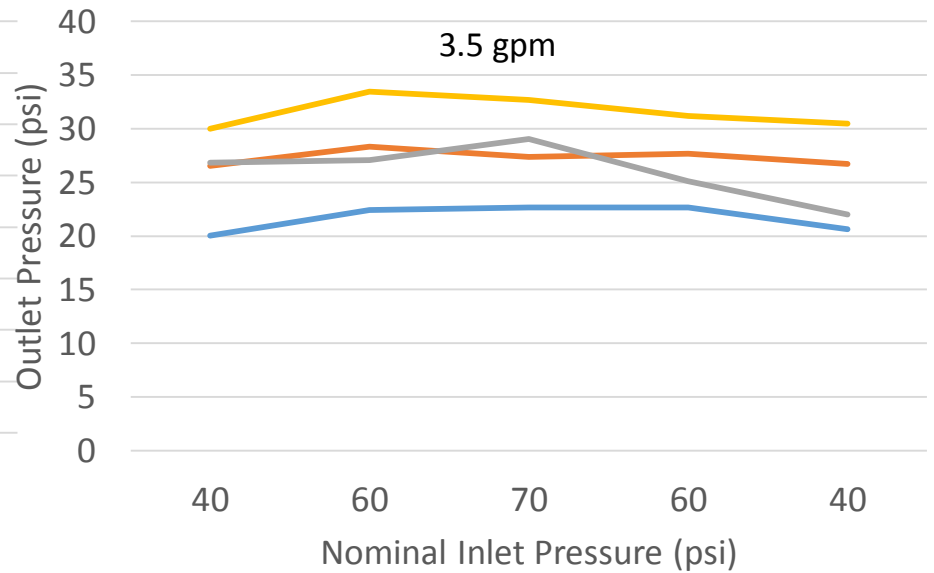
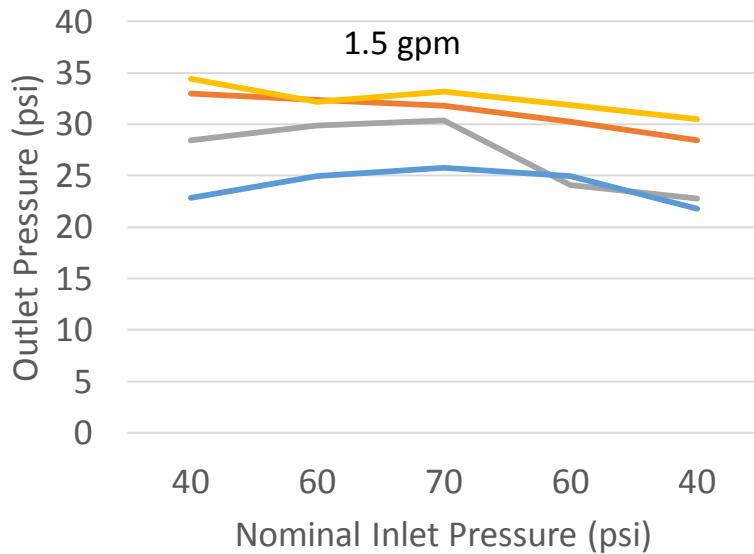
Flowrate Reduction – PRB vs. Non-PRB @ 3.5 gpm



Average Flowrate Reduction – PRB vs. Non-PRB



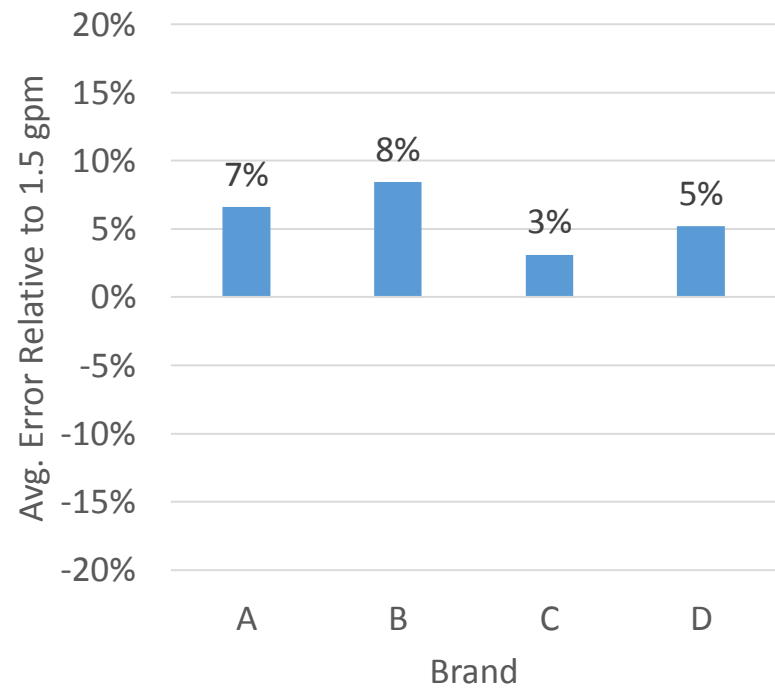
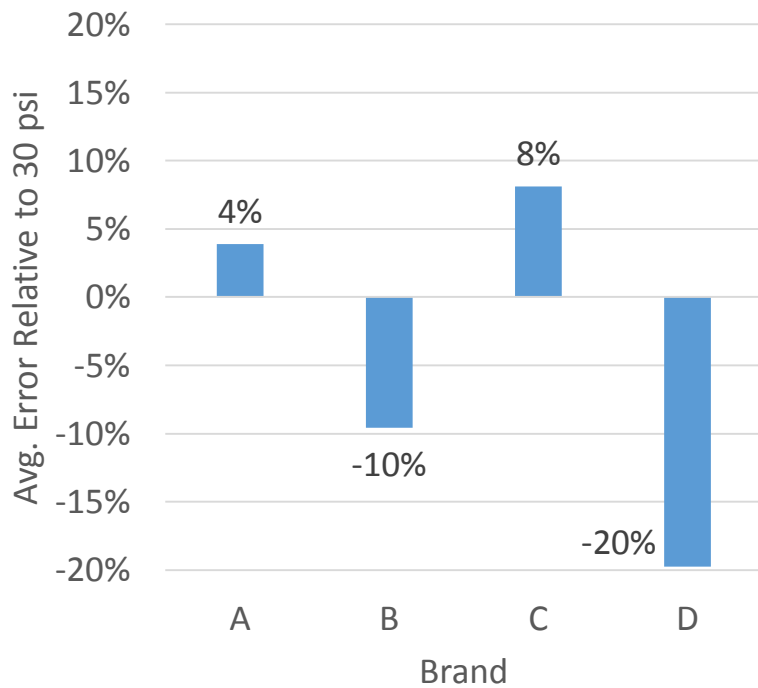
PRB Outlet Pressure



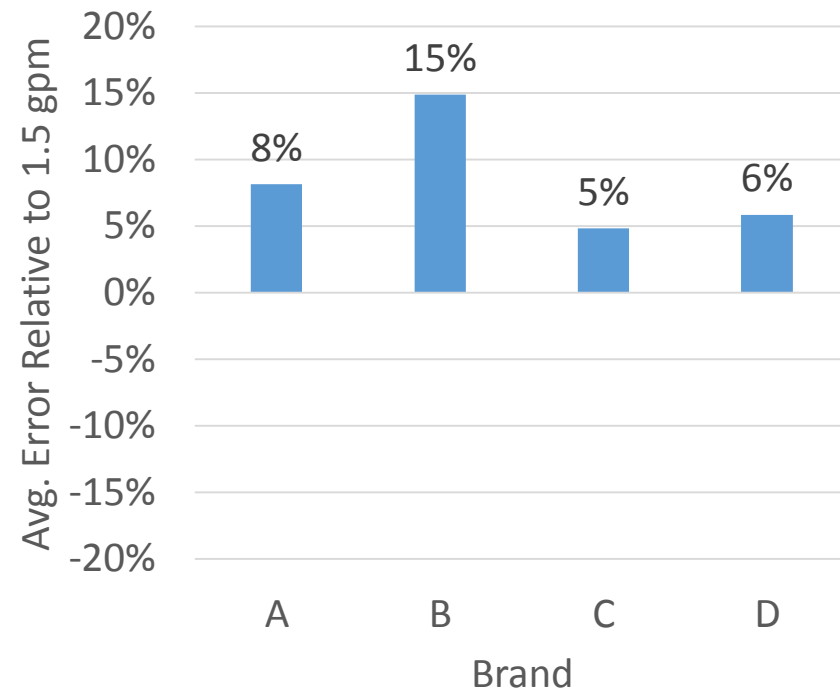
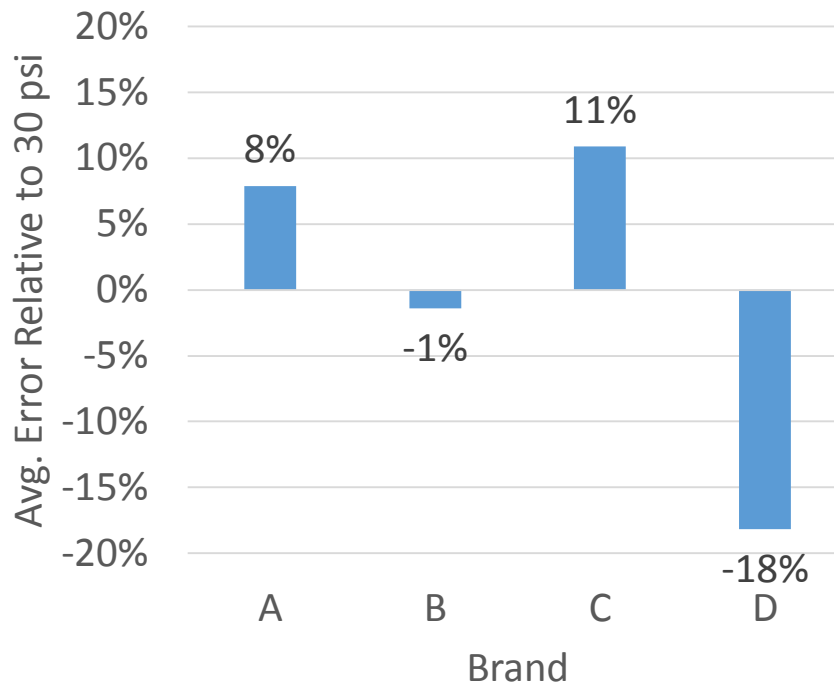
Brand A Brand B Brand C Brand D

Brand A Brand B Brand C Brand D

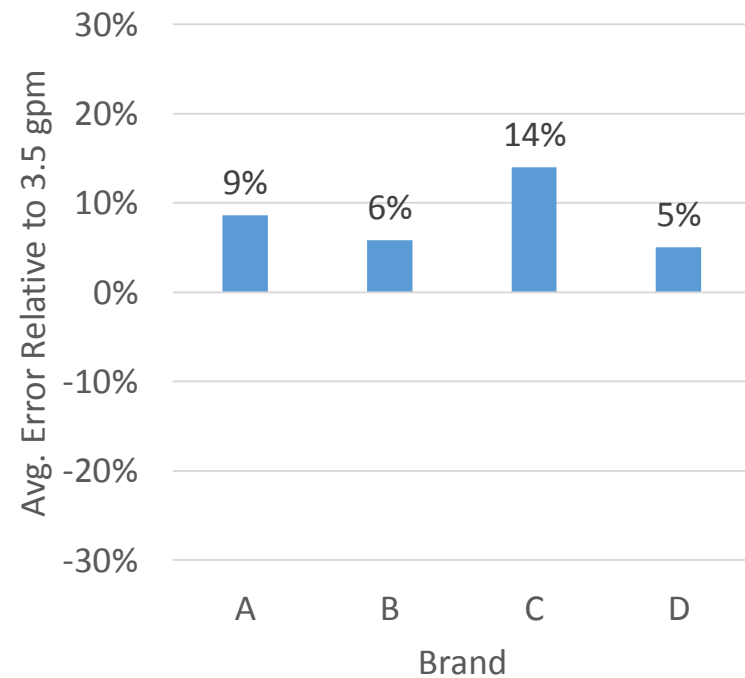
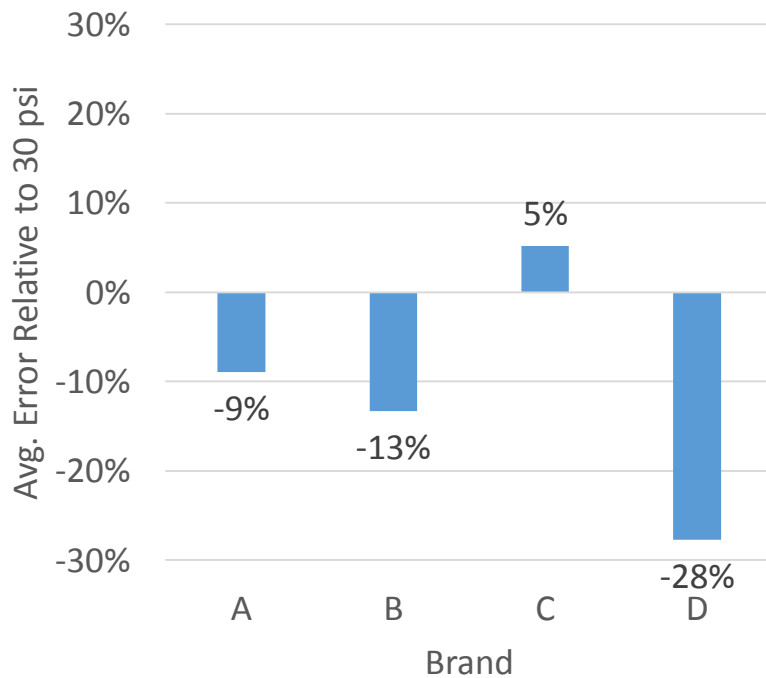
Average Pressure & Flowrate Error – 1.5 gpm



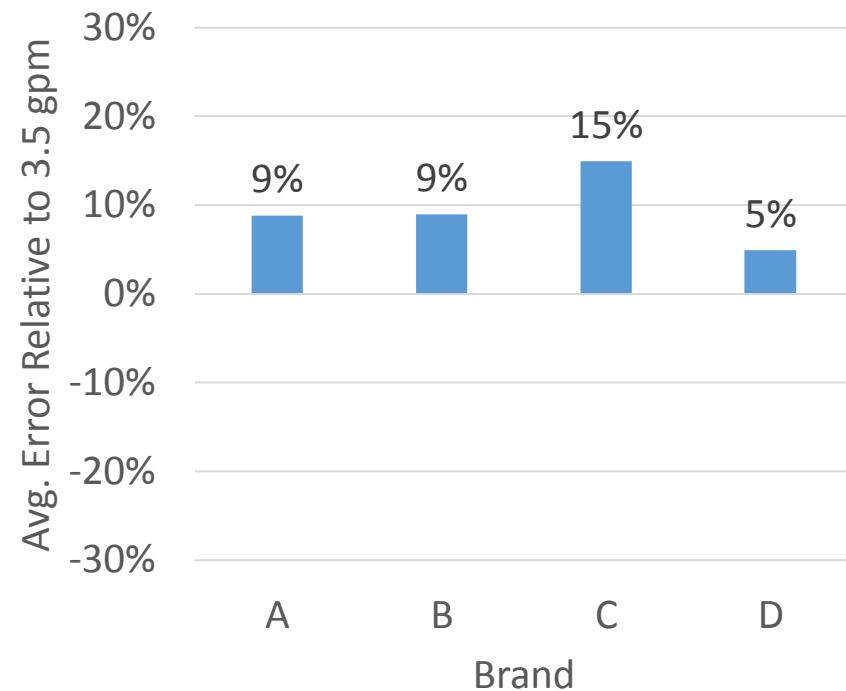
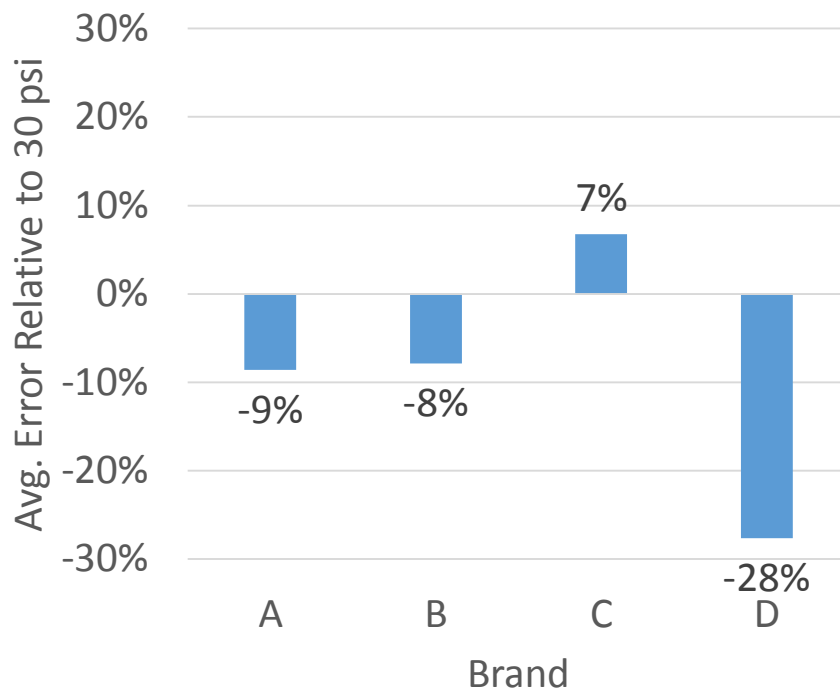
Average Pressure & Flowrate Error Rising Limb – 1.5 gpm



Average Pressure & Flowrate Error – 3.5 gpm



Average Pressure & Flowrate Error Rising Limb – 3.5 gpm

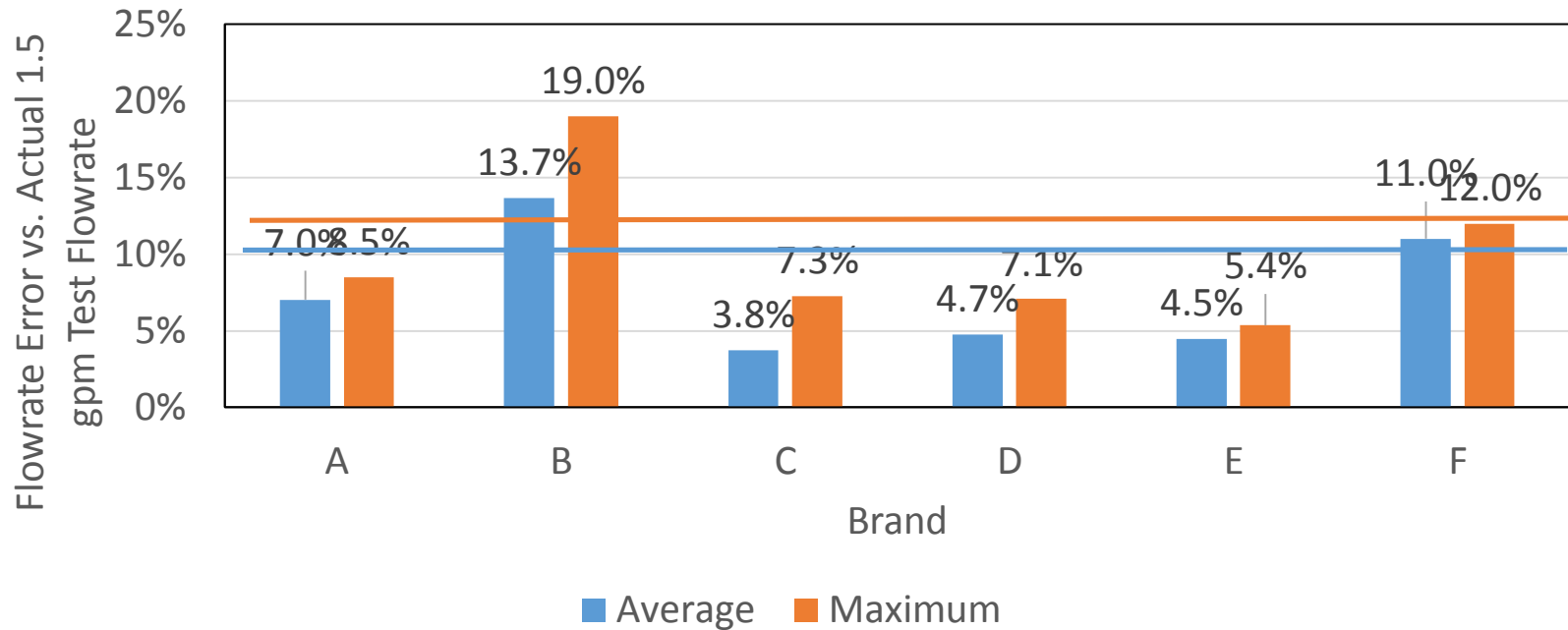


Recommendations

- Consider testing only the rising limb of pressure, e.g. for a 30 psi PRB, 40, 60, 70 psi test
- No compelling difference between 1.5 gpm & 3.5 gpm results
- Consider testing only 1.5 gpm since this flowrate is similar to the majority of sprinklers in the field
- Consider a maximum of 10-15% plus/minus deviation in peak flowrate at 1.5 gpm
- Consider average flowrate deviation maximum of 10-15% plus/minus at 1.5 gpm

Error Analysis on Individual Samples

Criteria: 1.5 gpm actual flowrate rising limb



EPA Spec Criteria

- Flowrate at max operating pressure compared to calibration flowrate shall be within +/- 12.0%
- Average of all test flowrates compared to calibration flowrate shall be within +/- 10.0%
- Average outlet pressure at initial calibration point shall not be less than 2/3 regulation pressure



Acknowledgements: EPA WaterSense Program